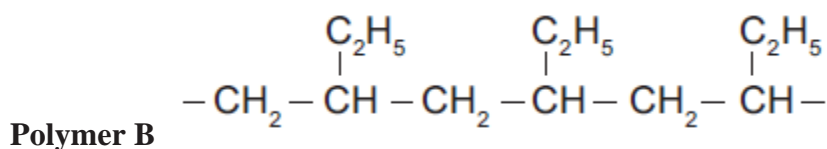
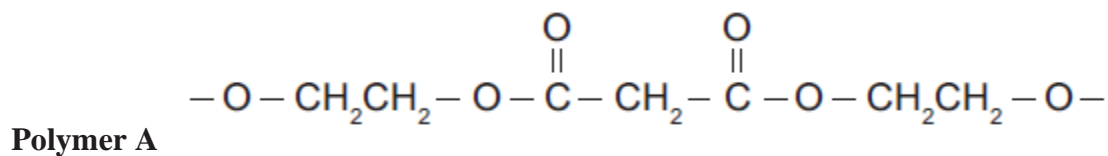


Polymers

1) The structures of Polymer A and Polymer B are given below.



a) Draw the monomers from which these polymers are made.

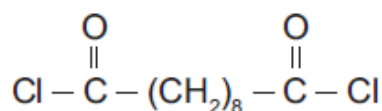
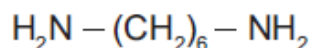
b) One of the polymers from above can be hydrolysed using NaOH(aq) . Identify the polymer and draw structures for the organic products of the hydrolysis.

c) Nylon 6,10 can be made from the monomers below.

sebacoyl chloride

(1,6-diaminohexane – a diamine)

(decanedioyl dichloride – an acid chloride)

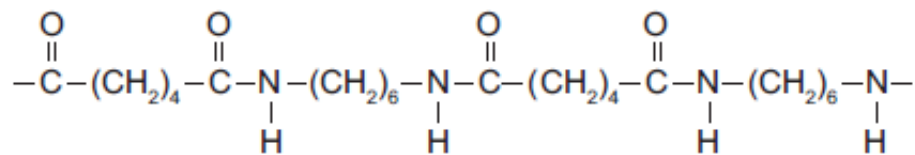


Steps for the formation of Nylon 6,10 are given below:

1. 2 g of the diamine is dissolved in 25 mL of water.
2. 2.5 mL of sebacoyl chloride is dissolved in 25 mL of a non-polar organic solvent.
3. The dissolved sebacoyl chloride is poured into the diamine solution.
4. 5 g of NaHCO_3 is added.
5. The nylon is extracted from the interface between the diamine and sebacoyl chloride layers.

- Identify the repeating unit of the polymer formed.
- Explain why the diamine is water soluble.
- Explain why the sebacoyl chloride is dissolved in a non-polar organic solvent.
- Explain why NaHCO_3 is added.

2a) Nylon 6,6 is a polymer with the following structure:



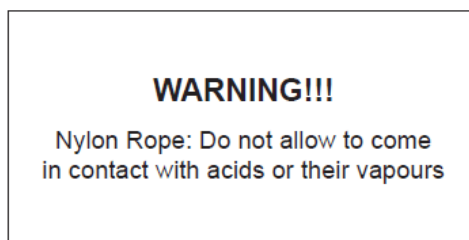
i) Circle an amide linkage in the structure above.

ii) Draw TWO monomers that could have formed this polymer.

b) Nylon 6 is formed from the monomer $\text{H}_2\text{N}-(\text{CH}_2)_5-\text{CO}_2\text{H}$.

i) Name this monomer and draw THREE repeating units of the Nylon 6 polymer chain

ii) Nylon is used for making ropes for climbing and abseiling. The ropes come with a warning label attached, such as that shown below.



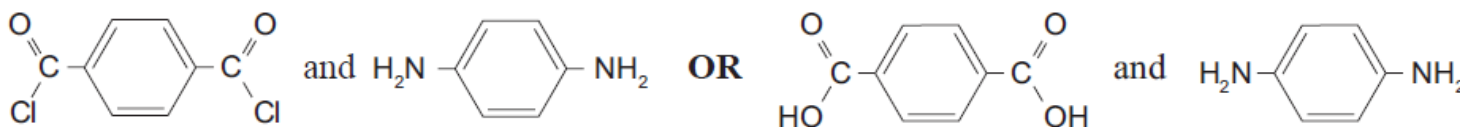
Discuss why this warning label is attached to nylon rope when purchased.

Include in your answer:

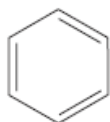
- the type of reaction that would occur
- relevant organic structural formulae
- any changes to the properties of the nylon rope.

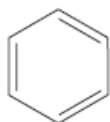
3) The polymer commonly known as Kevlar is used to make bullet-proof vests and bicycle tyres.

It can be made in a condensation reaction from either of the following pairs of monomers:



However, the second pair of monomers needs to be heated for the polymerisation reaction to take place.



Note:  is a benzene ring and should be treated as a hydrocarbon chain. It is not a functional group and does not change during the reaction.

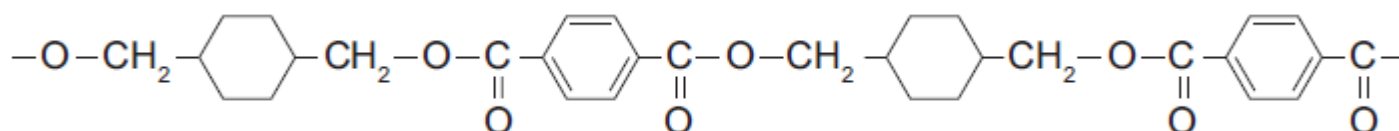
Discuss these polymerisation reactions.

Your answer should include:

- a repeating unit of the polymer chain

- reasons for the choice of monomers
- identification of the functional group in the polymer
- a reason why this is classified as a condensation reaction
- a comparison of the two pairs of monomers, including the reason that the second reaction will not take place without heating.

4) a) Kodel is a polymer with the following structure:



- Identify TWO monomers for this structure.
- Explain why this type of polymer is known as a condensation polymer.

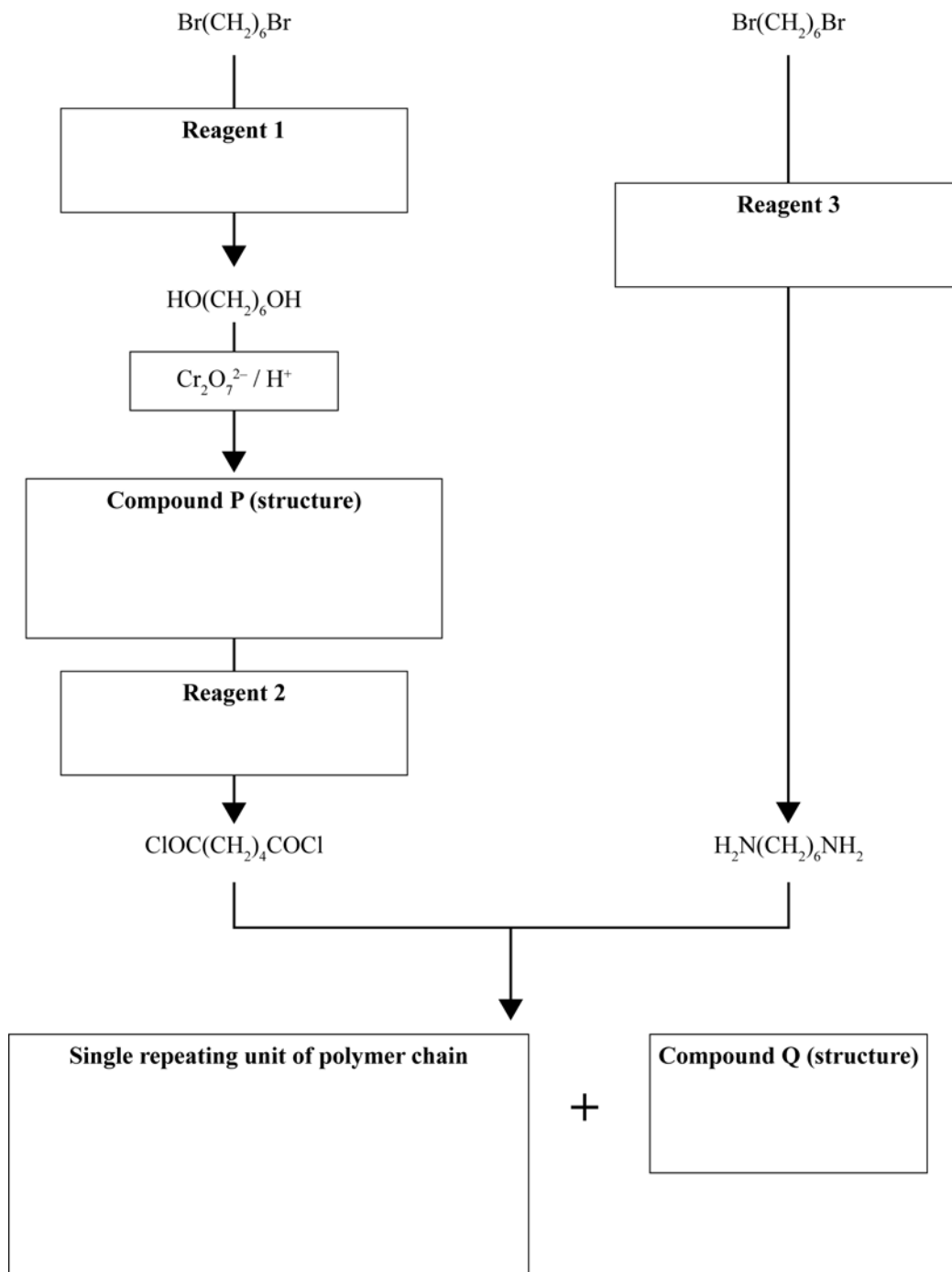
b) Compound **X** is a polymer which can be hydrolysed to give a single monomer, Compound **Y**, which has the molecular formula $C_3H_6O_3$.

Draw a section of the polymer, Compound **X**, showing at least two repeating units.

5) Lactic acid $\begin{array}{c} H_3C-CH-COOH \\ | \\ OH \end{array}$ is able to form a condensation polymer in the presence of dilute sulfuric acid. Draw three repeating units of this polymer.

6) a) The reaction scheme below shows formation of a section of a nylon polymer chain. Complete the reaction scheme by:

- identifying reagents 1, 2 and 3,
- drawing the structures of compounds P and Q,
- drawing a single repeating unit for the nylon polymer formed.



b) Nylon is used as a fibre to manufacture ropes and fabrics. These products can be damaged if they come into contact with acidic solutions. Teflon is a polymer formed from $\text{F}_2\text{C}=\text{CF}_2$ and is not affected by contact with acidic solutions.

Discuss why nylon is affected by acidic solutions while Teflon is not. Use structural formulae and equations where appropriate.

7) Consider the following statement.

***Polyesters** are **polymers** that can be made from two different **monomers** or from a single monomer.*

Discuss this statement, using the structures of specific monomers and the polyesters that can be made from them, to illustrate your answer. Your answer should demonstrate a clear understanding of the highlighted terms.